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Evolution of Sensor-Based Data Services for Collaborative Research

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Over the past decade, Web 2.0 has enabled sharing of resources in many new and exciting ways, fostering collaboration within the earth-sciences community. The evolving capabilities have spawned an expectation that data will be fully-describe so that it can be re-purposed from the original purpose of collection. The descriptions are expected to enable machine-to-machine exchange, for both near-term and long-term consumption. The need for standards in web-based services has led to the development of many frameworks for data discovery and delivery, but the use of common content and community adopted standards enables exchange of information across frameworks.

The ability to evaluate data and to discover the source of the data builds a solid foundation of trust for web-based systems of sharing information. Collaborative work environments must enable the discovery of data sets and their components, while providing the ability to track and acknowledge provenance. Once data are discovered, it is imperative that its origin, ownership and sensor and processing history be accessible, enabling the evaluation of the resource for any new application. Along with discovery and assessment, security authentication must be properly and easily administered. If data are live or updated, subscription service(s) should be provided with update notification as to when new or updated data are available, as well as any events that affect the data quality or provenance.

In the earth sciences community, there are shared attributes that can be used to develop common content. One attribute is the fact that environmental observations originate with a sensor system. Sensors have common ways to be described, such as model number, firmware version, serial number and capabilities. They also have properties that are being observed (“inputs”) and parameters that are required to convert the measurements into meaningful data (“outputs”). Sensor generated data also have lineage, including history, with events such as “initial deployment”, “redeployment”, “sensor maintenance”, etc. Typically, observations are logged, processed and then served to the web. This requires a means to track and document processing. Use of collaborative work environments can promote the development of shared QC tests, enabling a common understanding of processing. Another shared attribute in earth observations is geo-location. Using standards to describe sensed in situ data enables machine-to-machine discovery, assessment and harvesting of sensor data for interdisciplinary studies. The Open-Geospatial Consortium (OGC) has developed and adopted standards to meet the needs of the earth sciences community.

The Martha’s Vineyard Coastal Observatory (MVCO) has a decade-long history of openly-shared meteorological and oceanographic data. Data distribution methods have evolved from simple anonymous ftp to a fully-described, sensor network built using OGC-compliant Sensor Web Enablement SWE frameworks.

Development of sensor specific templates from manufacturers and tools to easily edit them for each deployment will bolster the use of shared data by making it easier for individual observers to publish fully-described sensor systems. The capabilities of the Web 3.0 will further promote shared knowledge of environmental data by enabling encoded (standards-based) relationships across disciplinary boundaries. Domain expert participation is necessary to validate the registration of authoritative ontologies, enabling semantic interoperability across domain-specific earth science communities. As the technical capabilities evolve, investment in the development of content requirements will broaden the impact of new functionality by enabling observational data use beyond the original scope and time-line, adding greater value to publicly funded research.